REMARKS

Status of Claims

Claims 1 – 24 were original in the application. Claims 25 – 40 were previously added. Claims 7, 12, 28, 31, 38 and 40 have been cancelled without prejudice to pursue in a continuation application. Claims 1, 17, 18, 24, 25, 29, 37, and 39 have been amended in this amendment. Claims 41 and 42 have been added. Claims 1 – 6, 8 – 11, 13 – 27, 29, 30, 32 – 37, 39, 41, and 42 are submitted for examination on the merits.

Rejection Pursuant to 35 USC 112

Claims 17, 18, 24, and 29 were rejected as being indefinite and have been responsively amended.

Claims 25 – 27, 29, 30, 32 – 37, and 39 were rejected as failing to comply with the written description requirement. The specification was unclear to the Examiner with respect to the limitations "nonconductive or nonmetallic specimen defining a plurality of posts for atom probe analysis" as recited in claims 25, 29, 37 and 39; "nonphotolithographically defining a plurality of regularly shaped posts" as recited in claim 29. The Examiner stated that it was not understood how the nonconductive or nonmetallic probe operated in a probe microscope apparatus for analyzing a sample; what was the method or apparatus nonphotolithographically performed to define the posts; or how the step of filling the supporting material in each microgroove was performed prior to cutting the microgrooves, which are formed by the step of cutting a slab? The Examiner requested additional explanation for these features in claims 25, 29, 37 and 39.

The invention is directed to a method for preparing a specimen for atom probe analysis and not to the operation of itself of atom probe analysis. It is well understood in the art that the specimen to be examined must be formed into a sharp tip. A positive potential is applied to the tip such that a very large electric field is present at the tip. The ambient gas surrounding the tip is usually Helium or Neon at a pressure of 1-3 x 10^{-3} millibar. The gas atoms move towards the tip and strike it. The gas atoms may strike the surface many times, before an electron from the gas atom tunnels into the metal tip leaving the gas atom positively ionized. The gas atom is then accelerated away from the tip where it strikes a fluorescent screen. The net effect of many gas atoms is to create a pattern on the fluorescent screen showing spots of light which correspond to individual atoms on the tip surface. The technique was invented by Erwin Müller in 1951. The atom probe is a related technique whereby a sudden voltage pulse is applied to the tip. This causes atoms on the surface of the tip to be ejected. The atoms travel down a drift tube where their time of arrival can be measured. The time taken for the atom to arrive at the detector is a measure of the mass of that atom. Thus compositional analysis of the sample can be carried out on a layer by layer basis. (See http://www.uksaf.org/tech/fim.html)

Thus, when the Examiner first questions how the nonconductive or nonmetallic sample is used in an atom probe microscope to analyze the sample, it can be readily understood that the first step is to appropriately provide the sample with a sharp tip. The invention provides a solution where a large number of appropriate shaped specimens can be economically manufactured for atom probe microscopy.

Second, the Examiner questions what was the method or apparatus for

nonphotolithographically defining the posts. The application discloses several methods which do not use photolithography. The preferred embodiment is sawing intersecting grooves into a substrate with a dicing saw to define an array of posts in the substrate and then fracturing the posts from the substrate. Any nonphotolithographic means for removing of the substrate to form intersecting grooves can be employed. Claim 25, for example, is generic to all means. In addition to mechanically sawing the intersecting grooves into the substrate with a dicing saw, there is disclosed electrical means, which includes electrostatic discharge machining, chemical means, which includes electrolytic and acid etching, and laser means, which includes laser ablation. (See application at page 4, lines 14 – 16).

Rejection Pursuant to 35 USC 102(b)

Claims 1 - 4, 8, 11, 14 - 26, 37 and 39 were rejected as being anticipated by **Larson et al.** "Advances in Atom Probe Specimen Fabrication from Planar Multilayer Thin Film Structures", Microsc. Microanal. 7, 24 – 31 (2001). The Examiner contended that **Larson** discloses in Figs. 1-10, a method for preparation of a specimen for an atom probe. The Examiner cited **Larson** for showing a method which includes lithographically defining a plurality of having prismatic sections posts in a slab having parallel and intersecting cutting grooves (see Fig. 2); removing the posts from the slab (see Fig. 3); mounting the post on a metallic pin (see Fig. 4); using FIB for shaping the post to a tip shape (see Fig. 5); filling an oxide film to serve as an etch stop for lithographic patterning of the posts (see page 26, lines 1-10 in left col.); and fracturing the posts from the slab by a knife or other sharp implement (see page 26, lines 7-11).

The claimed invention is an improvement over **Larsen**, whose earlier work is cited in the prior art section of the application. Obtaining usable substantially nonconductive specimens for atom probe analysis in quantity and quality at an economic price was the problem which **Larsen** failed to solve. Larsen obtained specimens in multilayer thin films, namely a sandwich of NiFe/CoFe/Cu. Unfortunately, geologic samples or rocks do not come as metallic layers and the teaching of **Larsen** of how to form atom probe samples from NiFe/CoFe/Cu thin films is unavailing or inoperable for geologic samples.

Claim 1 as amended calls for the use of a definition of the posts without lithography. Claims 25, 37 and 39 call for a substantially nonconductive specimen. **Larsen** does **not** disclose forming specimens using cross sawing, is directed to only conductive specimens and uses lithography to define the posts. It cannot be sustained that **Larsen** discloses each and every element of claims 1, 25, 37, and 39.

Claims 2 - 4, 8, 11, 14 – 24, and 26 depend directly or indirectly on one of claims 1, 25, 37 and 39 and are allowable therewith and for such further novel limitations combined therewith.

Rejection Pursuant to 35 USC 103(a)

Claims 5, 6, 9, 10, 13, 27, 29, 30, and 32 - 36 were rejected as obvious over **Larson** which the Examiner contended disclosed all the features except cutting the grooves with a saw as recited in claims 5, 13, 27, and 32; nonphotolithographically defining a plurality of regularly shaped posts in the slab as recited in claim 29; removing the material by mechanical means as recited in claim 9; removing the material by

electrical means as recited in claims 10 and 30; and separating a section having a plurality of posts from the slab as recited in claim 34. The Examiner contended that using a saw, mechanical means, electrical means or laser means to cut the grooves in the slab for defining the posts, or nonphotolithographically defining a plurality of regularly shaped posts is considered to be an obvious variation in design, since the saw, mechanical means, electrical means or laser means is nonphotolithographically conventionally used equipment to cut material (citing lines 8 - 20 of page 12 of the specification and a mechanical cutter 22 in Fig. 2 of **Ishikawa**), thus would have been obvious to one skilled in the art to use nonphotolithographically the saw, mechanical means, electrical means or laser means to cut the specimen in **Larson** as **Larson** discloses lithographically defined silicon post structures (see Fig. 2). The Examiner contended that separating a section having a plurality of posts from the slab is an obvious variation in design, since separating the section having a plurality of the posts from the slab and a single post from the slab have the same results for making the atom probes, thus would have been obvious to separate the section having a plurality of posts from the slab in the **Larson** for making the atom probes as **Larson** discloses making a single probe in each process.

The Examiner asserts that in the claimed combination the use of various material removal means to make atom probes would be obvious, notwithstanding the extremely small size of the sample and the stringent requirement for a sharp tip being formed. It has always been possible to produce samples for atom probe analysis with the required small size and sharp tip, but the cost and time required to do so in substantially nonconductive materials has been beyond the reach of the prior art. **Larsen** discloses

nothing which is useful for mass production of samples for atom probe analysis. **Ishikawa** in Fig. 2 appears to show a beveled grinding wheel which forms shallow pyramidal structures 24, but even here the teaching is expressly limited to conductive materials (see paragraph 0015 at page 9) and the pyramidal structures 24 are never separated from each other. Instead, an extraction electrode is scanned over the array of pyramidal structures 24 in ultra-high vacuum making measurements until a full data set is obtained. (see paragraph 0018) It can be deduced that shallow pyramidal structures 24 cannot be separated from their underlying substrate to provide separable samples. Further, in regard to claim 1 structures 24 are not cut deeply enough to allow them to be fractured from the substrate, which in turn renders their separation from the substrate into individual specimens impossible.

The Examiner argues that since the Applicant's own disclosure states that sawing can be replaced by other means used for micromachining such as electrostatic discharge machining, acid etching, saw cutting, and laser micromachining, that these other means are rendered obvious. This does not follow. The Applicant's own disclosure of the range of equivalency to a claimed step can never be a basis for a section 103 rejection.

Although it is unclear, it appears that the Examiner may be rejecting claims 5, 6, 9, 10, 13, 27, 29, 30, and 32 - 36 on the grounds that the subject matter is common knowledge with respect to the methods for mass production of samples for atom probes. Applicant challenges this contention under MPEP 2144(c) as not properly officially noticed or not properly based upon common knowledge in that at the subject size of the samples, the subject properties of the materials at this size, including

particularly nonconductive materials, it was believed that samples could only be reliably mass produced for atom probe analysis by using lithographic methods, and generally only for conductive materials, as evidenced by the cited art. The invention has shown this not to be the case. Arguments concerning the obviousness of the inventive solution are entirely reliant on hindsight derived from the proven results of the invention.

Applicant respectfully requests advancement of the claims to allowance.

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on January 7, 2005 ~~by~~

Signature

January 7, 2005

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